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P1.1046 Dynamics and spectral properties of Turbulence-Driven Magnetic Islands

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Neoclassical tearing modes (NTM) are metastable magnetic islands in tokamaks; however, they appear frequently in experiments without any noticeable triggering event. In order to understand this, it has been numerically shown that turbulence can create a seed island by mode coupling [1, 2, 3], even remotely [4] ; such a seed island can indeed be large enough to further grow from the NTM mechanism [5].
However, this amplification only happens for islands larger than a critical size. Therefore, the definition and determination of the size of turbulence-driven magnetic islands is of crucial importance.
First, the definition of island size is more ambiguous in a turbulent context than in a quiescent, tearing mode context. Different definitions of the island size are discussed, as well as the associated diagnostics that can be implemented in numerical codes.
Next, we use 3D reduced-MHD simulations of flux-driven ballooning turbulence to study the seed island creation in regimes where the classical tearing mode is linearly stable. A localized pressure source is used to control the radial position and strength of the turbulence, and allows to radially separate turbulent region from q = 2 island resonant surface.
We show that the onset of the magnetic island on the q = 2 surface follows complex dynamics that can be split into several distinct phases: as a first step the nonlinearly dominant mode in the turbulent region drives a weak harmonic island on the q = 2 surface. Subsequently the spectrum on the q = 2 surface evolves towards larger scales. The final dominant island mode depends on the power source that feeds the turbulent region; this can lead to an oscillating behaviour when the peak of the final island spectrum lies between integer harmonics.

References
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